

CHM 1143

Exam 2

TUD Department of Chemistry

Fall 2017

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#1-#5 20 points each

Multiple choice 10 points each

with 2 free misses

- 1) 65 g of $C_6H_{12}O_6$ was dissolved in 450 g of water. Calculate the boiling point of the solution. ($k_{bp} = 0.52 \text{ } ^\circ\text{C}/m$ for water).

$$\frac{65g}{180g/mol} = 0.36 \text{ mol } C_6H_{12}O_6$$
$$m = \frac{0.36 \text{ mol}}{0.45 \text{ kg}} = 0.80 m$$

$$\Delta T = k_{bp} \cdot m = \left(0.52 \frac{^\circ\text{C}}{m}\right)(0.80 m)$$
$$= 0.42 \text{ } ^\circ\text{C}$$

$$BP = 100^\circ\text{C} + 0.42^\circ\text{C} = 100.42^\circ\text{C}$$

- 2) 55.0 g of ethanol (C_2H_6O) was added to water. The resulting solution was 0.45 molal. What was the mass of the water?

$$\frac{55.0g}{46g/mol} = 1.2 \text{ mole EtOH}$$
$$m = \frac{\text{mol solute}}{\text{kg solvent}}$$

$$\text{kg soln.} = \frac{\text{mol solute}}{m} = \frac{1.2 \text{ mol}}{0.45 \frac{\text{mol}}{\text{kg soln}}} = 2.7 \text{ kg}$$

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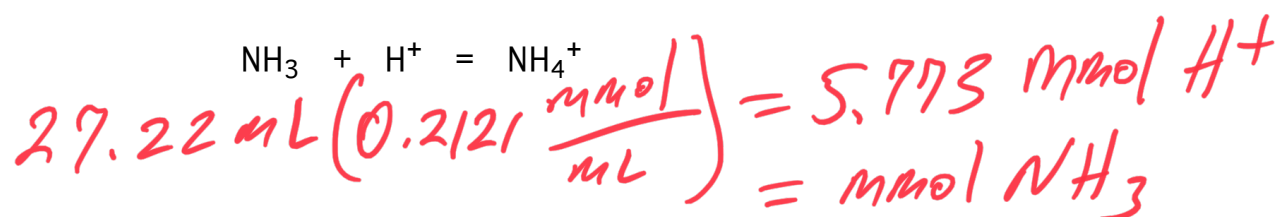
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- 3) Titration of 25.00 mL of an aqueous ammonia solution required 27.22 mL of 0.2121 M HCl. What was the $[\text{NH}_3]$ in the ammonia solution?



$$[\text{NH}_3] = \frac{5.773 \text{ mmol}}{25.00 \text{ mL}} = 0.2309 \text{ M}$$

- 4) Concentrated HClO_4 has a density of 1.67 g/mL and contains 71% HClO_4 by weight. Calculate the molarity and molality of the solution.

$$\begin{array}{l} 1000 \text{ g} \\ \times 0.71 \\ \hline 710 \text{ g HClO}_4 \\ 710 \text{ g HClO}_4 \\ \hline 101 \text{ g/mol} \\ \hline = 7.0 \text{ mol HClO}_4 \\ \\ m = \frac{7.0 \text{ mol}}{0.29 \text{ kg H}_2\text{O}} = 24 \text{ m} \end{array} \quad \left| \quad \begin{array}{l} 1000 \text{ mL} \left(1.67 \frac{\text{g}}{\text{mL}} \right) = 1670 \text{ g} \\ \times 0.71 \\ \hline 1190 \text{ g HClO}_4 \\ \\ \frac{1190 \text{ g}}{101 \text{ g/mol}} \\ \hline = 12 \text{ M} \end{array} \right.$$

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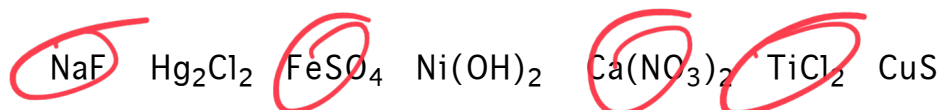
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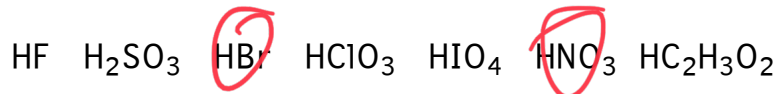
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5) a) Circle the water soluble compounds



b) Circle the strong acids



c) Circle the compounds which act as weak bases in water



d) What is the critical temperature of a substance?

Temperature above which gas cannot be condensed to a liquid

e) Calculate the density of Kr gas at 298 K and 1 atm ($R=0.08205 \text{ L atm/mol K}$)

$$PV = nRT = \frac{g}{M} RT$$
$$d = \frac{g}{V} = \frac{P(M)}{RT} = \frac{(1 \text{ atm})(83.8 \text{ g/mol})}{R(298)}$$
$$= 3.4 \frac{\text{g}}{\text{L}}$$

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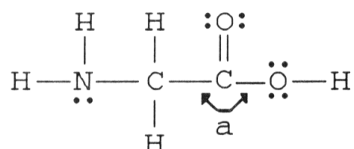
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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The bond angle marked a in the following molecule is about _____.



- A) 120° B) 180° C) 60° D) 90° E) 109.5°

2) In liquids, the attractive intermolecular forces are _____.

- A) not strong enough to keep molecules from moving past each other
B) strong enough to hold molecules relatively close together but not strong enough to keep molecules from moving past each other
C) very weak compared with kinetic energies of the molecules
D) strong enough to hold molecules relatively close together
E) strong enough to keep the molecules confined to vibrating about their fixed lattice points

3) Which one of the following exhibits dipole-dipole attraction between molecules?

- A) PH_3 B) $\text{C}_{10}\text{H}_{22}$ C) CO_2 D) Br_2 E) CCl_4

4) Which one of the following should have the lowest boiling point?

- A) CH_4 B) NH_3 C) HCl D) H_2S E) CH_3OH

5) Of the following substances, _____ has the highest boiling point.

- A) N_2
B) $\text{CH}_3\text{CH}_2\text{OH}$
C) $\text{HOCH}_2\text{CH}_2\text{OH}$
D) C_2H_6
E) F_2

6) Elemental iodine (I_2) is a solid at room temperature. What is the major attractive force that exists among different I_2 molecules in the solid?

- A) covalent-ionic interactions
B) dipole-dipole repulsions
C) dipole-dipole attractions
D) London dispersion forces
E) ionic-dipole interactions

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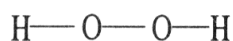
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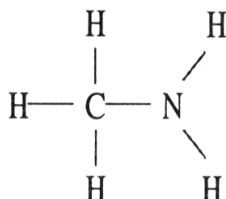
7) Which one of the following substances will not have hydrogen bonding as one of its intermolecular forces?

7) E

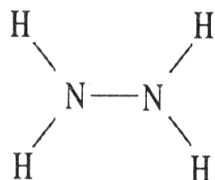
A)



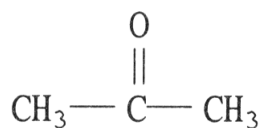
B)



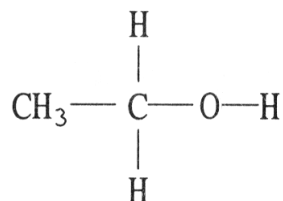
C)



D)



E)



8) Which of the following molecules has hydrogen bonding as its only intermolecular force?

8) E

A) H_2O

B) $\text{C}_6\text{H}_{13}\text{NH}_2$

C) HF

D) $\text{C}_5\text{H}_{11}\text{OH}$

E) None, all of the above exhibit dispersion forces.

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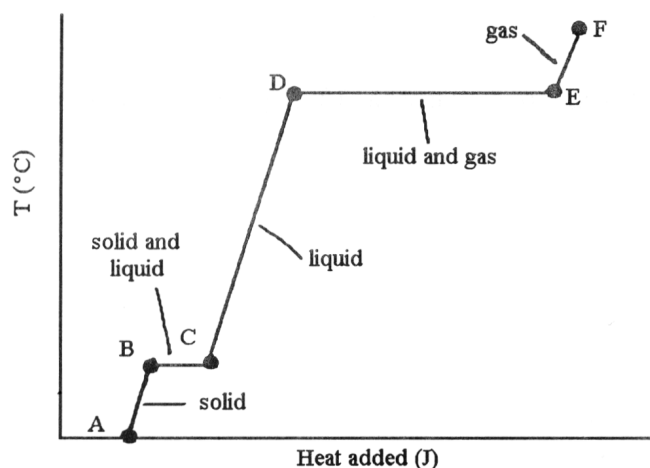
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9) The phase changes B → C and D → E are not associated with temperature increases because the heat energy is used up to _____.

- A) increase distances between molecules
- B) increase the velocity of molecules
- C) increase the density of the sample
- D) break intramolecular bonds
- E) rearrange atoms within molecules

9) A

10) The vapor pressure of a liquid _____.

- A) decreases linearly with increasing temperature
- B) decreases nonlinearly with increasing temperature
- C) increases linearly with increasing temperature
- D) is totally unrelated to its molecular structure
- E) increases nonlinearly with increasing temperature

10) E

11) A solution with a concentration higher than the solubility is _____.

- A) is unsaturated
- B) is supersaturated
- C) is not possible
- D) is supercritical
- E) is saturated

11) B

12) Which one of the following substances would be the most soluble in CCl_4 ?

- A) NH_3
- B) $\text{CH}_3\text{CH}_2\text{OH}$
- C) NaCl
- D) H_2O
- E) $\text{C}_{10}\text{H}_{22}$

12) E